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ABSTRACT
This paper examines how the systematic risk of large commercial real estate owners is associated with geographic diversification. It analyzed time-varying equity betas and geographic exposure of publicly traded pure-play lodging REITs. Contrary to popular expectation, results of this study showed that stock investors perceive smaller risk in geographic focus rather than in diversification. Further, regional focus becomes insignificant in reducing the risk if the focus expands beyond two or three regions. The findings were robust to multiple measures of geographic diversification. As such, the study reaffirmed the impact of geographic focus in the context of commercial real estate as a risk minimization strategy.

Keywords: geographic diversification, hotels, REITs, systematic risk, stock markets

Introduction

Firms diversify their product portfolio aiming to capture a diverse range of cash flow streams and minimize the risk. The total risk a firm is exposed to has two main components: systematic and firm-specific. In theory, the latter can be diversified away although the systematic risk cannot. Therefore, the systematic risk affects a company's cost of equity and is priced as such. As equity investors price this risk based on their perception of the risks involved with a firm's business, the firms respond by attempting to minimize this risk through diversification. One such strategy is aimed at geographic diversification (J. C. Hartzell et al., 2014). Tourism and hotel industries, in particular, are known for their preference for diversification (Sharpley & Vass, 2006; S. Lee, 2008; Das, Smith, & Gallimore, 2018).

While conventional wisdom suggests a negative association between diversification and risk, the notion of diversification deserves more careful consideration. Location-specific businesses such as real estate and hotels may need to employ local know-how to manage their assets. Thus, geographic diversification may pose managerial challenges (Landier et al., 2009; John et al., 2011; Cashman et al., 2014; Das & Thomas, 2016), which may lead to uncertainties. Lodging-focused, publicly traded Real Estate Investment Trusts (REITs) offer an appropriate sample to test the impact of geographic diversification on systematic risk. As Figure 1 suggests, REIT-owned hotels exhibit vast geographic footprint.

With its lodging focus and regulatorily required focus on operating real estate assets, our sample represents hotel ownership businesses, and the publicly traded status of REITs affords us the required data to test the association. With the REIT status, a real estate owner avoids corporate taxation by meeting certain criteria, such as restricting most assets, operations, and income to real estate assets and distributing most of the taxable income to shareholders. By 2015, U.S. REITs had a market capitalization of nearly $900 billion and have become a popular mechanism of holding hotel real estate (Jackson,

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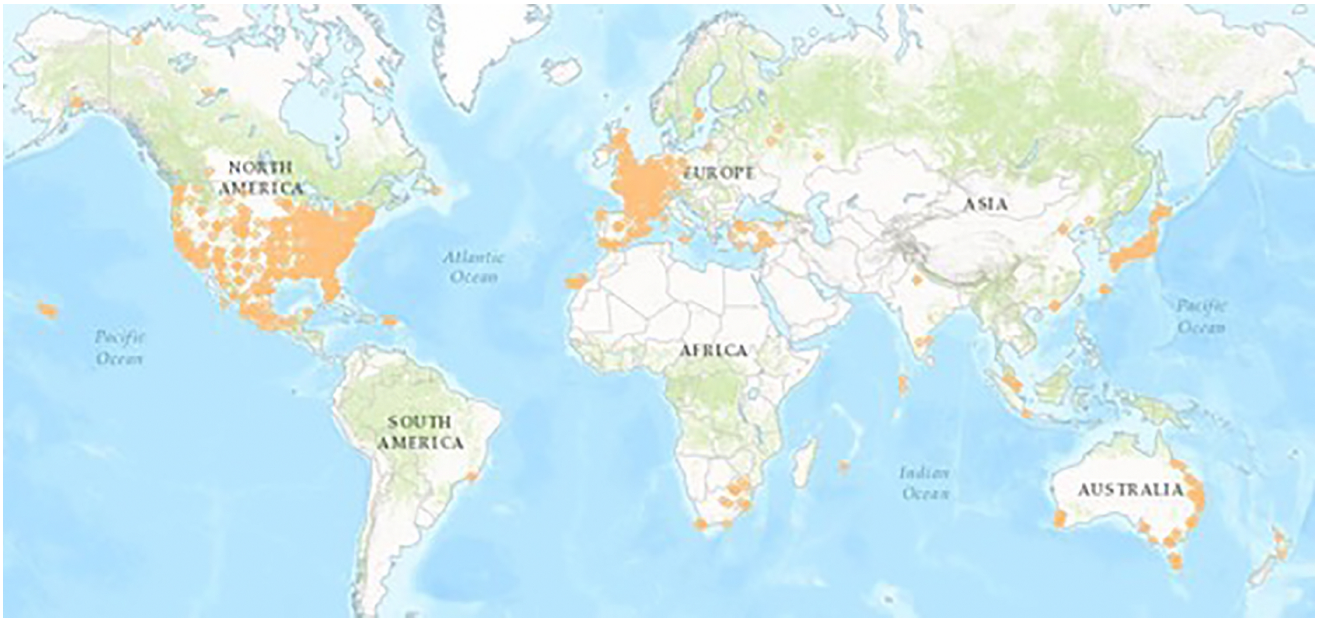

Figure 1. *Geographic Footprint of Hotels Owned by REITs Worldwide*
Source: Authors, ESRI.

2008; J. Kim & Jang, 2012). Yet, earlier studies on the systematic risk of REITs (such as Gyourko & Nelling, 1996; Adams et al., 2015; Sing & Patel, 2001; Eichholtz et al., 1995; S. Lee & Byrne, 1998; Ling et al., 2018) have broadly ignored the lodging sector (Manning et al., 2015; Worsley, 2015). Besides, the geographic diversification strategy has received limited attention from the scientific community (Ling et al., 2018) in general. To our knowledge, this is the first study to associate geographic diversification with systematic risk in lodging REITs.

We developed time-varying property portfolios of 17 lodging REITs listed on U.S. stock exchanges between 1997 and 2016 on a quarterly basis. We utilized multiple measures of geographic focus (which is the converse of diversification) from this data such as the Herfindahl index and the entropy index across selected top regions (by REIT-specific asset share). We enhanced the dataset with stock market and firm-specific financial data and applied the dataset to fixed-effects panel data analysis. In line with earlier studies (Gyourko & Nelling, 1996; Byrne & Lee, 2011; Cheng & Roulac, 2007), we found a significant link between geographic exposure and beta. However, contrary to earlier studies, we discovered that REITs with geographically concentrated hotel portfolios experience significantly lower systematic risk. The introduction of a new region in the portfolio rather increases the beta by 0.06 to 0.08. Geographic focus measured by the Herfindahl index has a negative association with the beta. Geographic focus in two regions is associated with the highest reduction in beta (−5 to −8) followed by reduction associated with three (−2 to −5). Focusing on too many geographic regions does not offer any significant reduction in the beta. Our findings are robust to multiple measures of geographic diversification and systematic risk, and are reported after controlling for known determinants of beta.

Background

Capital markets price the systematic risk in a security, which cannot be diversified away.

In stocks, such risk is measured by the stock market beta. Based on the Capital Asset Pricing Model (CAPM) developed by Sharpe (1963, 1964) and Lintner (1965) the systematic risk (β_i) is defined as the extent of exposure a security (i) has to the market. The beta is estimated based on the following model:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f] \quad (1)$$

Here, $E(R_i)$ is the expected return of security i, R_f is the risk-free rate, R_m is the return of the market portfolio, and β_i is the systematic risk of the security i. The beta can be estimated using a time-series

regression (Sharpe et al., 1974) as follows, where subscripts t and i index time and security, respectively:

$$R_{i,t} = \alpha_i + \hat{\beta}_i R_{m,t} + \varepsilon_t \quad (2)$$

In Equation (2), α_i is the coefficient of the intercept, $\hat{\beta}_i$ is the coefficient of the slope, and ε_t is the error term. The systematic risk expresses investors' expectations about how security i will be affected by macroeconomic factors. Financial literature suggests that the beta can be influenced by a firm's (financial) policies such as leverage, liquidity, dividends, investment (growth), and profitability (Logue & Merville, 1972).

REITs, Systematic Risk, and Diversification

In 1960 REITs were created by the U.S. Congress to make investing in large income producing real estate possible for all investors. Beginning in 1993, REITs have become increasingly focused in specific types of real estate (H. Kim, Gu, & Mattile, 2002; Das, Ziobrowski, & Coulson, 2015). Hotel REITs, in particular, represent nearly 4.5% of the FTSE NAREIT All REITs Index based on market capitalization (NAREIT, 2015). Ro and Ziobrowski (2011) reported that most REITs are specialized in one property type based on the belief that there is a specific management expertise based on property type. However, their comparison between specialized and diversified REITs showed that the systematic risk of specialized REITs is higher. Others have focused on comparing the performance of specialized REITs among each other and found that lodging REITs are the most volatile (Jackson, 2009; Worsley, 2015) and, by inference, face the challenge of developing specific strategies to minimize the risk (Low et al., 2015).

One such strategy is to diversify the property portfolio geographically (H. Kim, Gu, & Mattila, 2002). Geographic diversification is one of the most common strategies employed for risk reduction by real estate investors (Cheng & Roulac, 2007; Cotter et al., 2015; Eichholtz et al., 1995; Nelson & Nelson, 2003; S. Lee & Byrne, 1998). In fact, geography is more commonly used as a means for diversification than diversification across property types (Sing & Patel, 2001). Yet, we could not find any study that empirically examined the impact of geographic diversification on the systematic risk of lodging REITs.

Disadvantages of Geographic Diversification

The notion of risk mitigation through geographic diversification is mostly anecdotal, and there is no strong consensus regarding the relationship between risk and geographic dispersion. Eichholtz et al. (1995) found potential for geographic diversification for retail real estate but not for office real estate in the United States. Cotter et al. (2015) found that there is a rather limited potential for risk reduction through geographic diversification in the U.S. housing market. In a contrasting stream of studies, John et al. (2011) showed that remote locations increase the cost of shareholder oversight thus leading to agency problems. As a result, a geographically remote location forces a firm to provide higher dividends. Landier et al. (2009) examined the impact of geographic dispersion on a firm's decisions. Their findings suggested that firms perceive more risk in a geographically dispersed portfolio. Firms are less confident about the "soft information" related to farther assets. Such an effect will be more pronounced in REITs due to localized nature of their main assets, i.e., real estate. Cashman et al. (2014) and Das and Thomas (2016) reported such issues specifically in the context of REITs. By inference, geographic diversification may aggravate the information available both to the managers and investors and may lead to agency problems that add to risk.

Measures of Geographic Diversification

Gyourko and Nelling (1996) used broad NCREIF[1] geographic classification of assets. However, the study did not report a significant association between equity beta and the region-specific distribution of assets. D. Hartzell et al. (1987) used the Salomon Brothers' eight regions (New England, Mid-Atlantic Corridor, Old South, Industrial Midwest, Farmbelt, Mineral Extraction Area, Southern California, and Northern California) with the aim of creating regions based on common economic factors ("Economic Regions," hereafter). Byrne and

[1] The National Council of Real Estate Investment Fiduciaries (NCREIF) divides the United States into specific regions.

Lee's (2011) findings, which suggest risk reduction due to diversification, concurred with the notion that economically based geographic diversification is superior to administratively based geographic diversification (e.g., NCREIF). Gyourko and Nelling (1996) regress the beta with a REIT's share of properties within specific regions. However, this method ignored the overall geographic focus (or lack thereof; i.e., diversification). J. C. Hartzell et al. (2014) used the number of regions (i.e., geographic footprint) in which a REIT owns properties to measure the extent of geographic diversification. Further, both of the above-mentioned studies employed the Herfindahl index as a measure of geographic focus as follows:

$$Herfindahl\ index = \sum_{i=1}^{N} P_i^2 \quad (3)$$

Where, P_i is the percentage of a REIT's total assets invested in region i and N is the number of geographic regions. If a REIT has a significant amount of its assets in a small number of regions this would increase the value of the index, which may reach the maximum of one if all assets are invested in only one region. Based on An et al. (2011), we also employed the entropy index as a measure of a REIT's portfolio focus in selected top regions as follows:

$$Entropy = -\sum_{i=1}^{N} s_i log_{N+1}\, s_i + (1 - \sum_{i=1}^{N} s_i) \; log_{N+1}(1 - \sum_{i=1}^{N} s_i) \quad (4)$$

Here, s_i is the proportion of the assets located in region i, which is one of the top N regions (by proportion of assets) in a REIT's real estate portfolio. N can assume any whole number less than the total number of regions in a portfolio. For a given N, the larger the entropy index, the higher the concentration of assets within the top N regions. While the number of regions (COUNT) in which a REIT owns assets reflects geographic diversification, the Herfindahl and entropy indices reflect the converse, i.e, geographic focus. For illustrative purposes, we constructed an imaginary property portfolio of ten REITs spread across eight regions, as shown in Figure 2.

With a decreasing geographic footprint (i.e., COUNT), the measures of geographic focus (Herfindahl and entropy indices) increase. For example, the entropy (for all N's) of REIT-2 is larger than

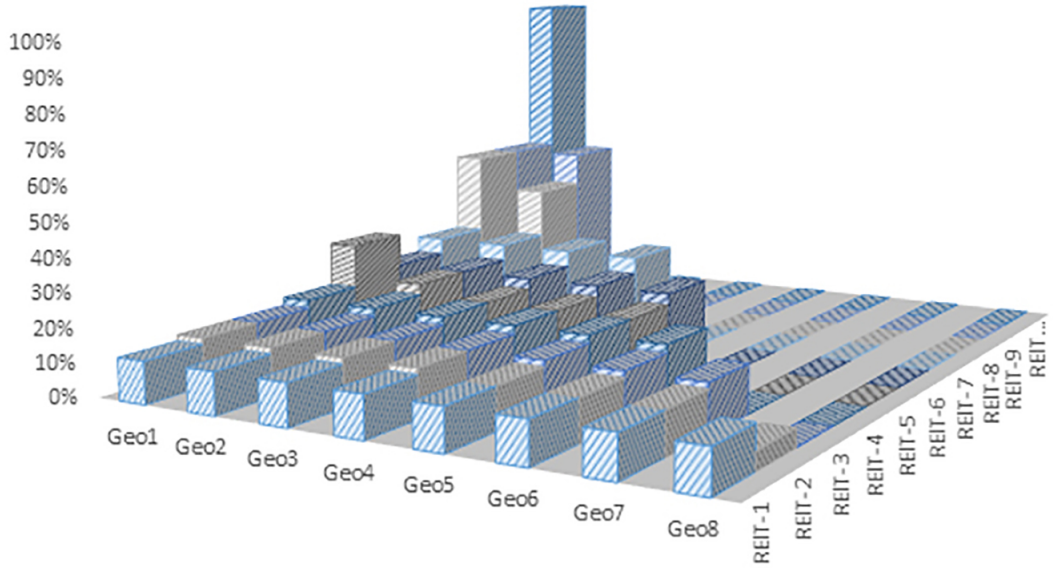

Figure 2. *Illustrative Example for Comparing Herfindahl Index to Entropy Indices*
Source: Authors. The image illustrates ten imaginary REITs with different asset allocations to an exhaustive set of eight geographic regions. This illustrative example is supported by Appendix Table 1, which lays out different geographic concentration measures for a REIT's geographic asset allocations.

that of REIT-1 implying that REIT-2 has more concentration of properties within its top *N* regions. However, one must not compare the entropy across *N*'s (top-2 regions versus top-3 regions) for a REIT because changing entropy across different values of *N* within a REIT may be a statistical artefact.[2] Similarly, the entropy and Herfindahl indices are not mutually comparable. As COUNT and Herfindahl indices use the universe of a REIT's portfolio information, the association between them is strictly negative. However, there is less redundancy between these measures and there may be a positive or negative correlation between Herfindahl and entropy indices for a given REIT. In Appendix Table 2 we present the correlation matrix of various Herfindahl and entropy measures across NCREIF and Economic Regions.

Data

We started with a sample of quarterly data on 20 REITs specialized in lodging properties. Three REITs[3] were excluded due to insufficient data. For the remaining 17 REITs, we retrieved their daily total return data from the SNL financial database, adjusted for dividends and stock splits. The quarterly return is the percentage change between the closing price of the last day of a quarter and the closing price of the last day of the following quarter. We extracted the risk-free rate, and the stock market factors from Kenneth French's website. Our choice of quarterly frequency was dictated by that of the financial information available for REITs from the SNL database.

The data on past property transactions, the location of the properties, and the current portfolio holdings of the REITs came from the SNL financial database. Starting with the current portfolio we re-created the past, time-varying portfolios by subtracting acquisitions and adding dispositions backward through time.[4] We applied this method to create the past geographic portfolios based on eight NCREIF regions ("NR") and the Salomon Brothers' eight economic regions ("ER") as classified by SNL financial.[5] However, unlike the Gyourko and Nelling's (1996) study, which was based on four NCREIF regions (East, Midwest, South, and West), we use a more granular classification of eight NCREIF regions (East North Central, Mideast, Mountain, Northeast, Pacific, Southeast, Southwest, and West North Central). We excluded the quarters preceding the earliest transaction data available for each REIT. For each quarter, once all the past portfolios were created based on number of properties we turned the counts into percentages of their respective REIT's total U.S.-based portfolio. Unfortunately, the data available on asset values or their cash flows is very limited. Besides, heterogeneous size calculation across property types (e.g., land acreage versus apartment units versus office suites versus hotel rooms) restricted our choice of geographic dispersion to be based on the property count. We also calculated the proportion of international properties of each REIT versus domestic properties over time and included it as a separate variable. Properties in Puerto Rico and the U.S. Virgin Islands were considered international properties as they do not fall into one of the NCREIF or Economic Regions. Due to the lack of information about the market value of the assets, we based our measures of geographic dispersion on the number of properties. Despite being hotel-focused, several REITs included in our study own non-hotel assets.

We extracted the data on control variables from the SNL financial database. Debt leverage is measured as total debt divided by total assets (J.-S. Lee & Jang, 2007; H. Kim, Gu, & Mattila, 2002) and is expected to be positively related to beta (Logue & Merville, 1972). Growth is the percentage change in total assets from one period to the subsequent one and is expected to positively affect beta (H. Kim,

[2] See Appendix Table 1 for details.

[3] Ashford Hospitality Prime, Xenia Hotels & Resorts, and Apple Hospitality REIT.

[4] In the transaction history data, there are two properties located in the United States for which we do not have the exact address. As these properties represent only 0.12% of overall transactions and less than 1.5% of the number of properties in the portfolio of their respective REIT, these properties were removed from the sample under the assumption that they do not have a significant impact.

[5] States are attributed to NCREIF regions as follows: (1) NE (Northeast): ME, VT, NH, NY, CT, RI, MA, PA, NJ; (2) ME (Mideast): MD, WV, VA, KY, NC, SC, DC, DE; (3) SE (Southeast): TN, GA, FL, AL, MS; (4) EN (East North Central): MI, IL, OH, IN, WI; (5) WN (West North Central): MN, IA, MO, KS, NE, SD, ND; (6) SW (Southwest): TX, OK, AR, LA; (7) MT (Mountain): MT, ID, WY, UT, CO, NM, AZ, NV; (8) PC (Pacific): WA, OR, CA, AK, HI.

J. Kim, & Gu, 2012; H. Kim, Gu, & Mattila, 2002; Logue & Merville, 1972). Profitability is controlled for with return on equity, which is net income divided by total equity (H. Kim, Gu, & Mattila, 2002). Liquidity is measured as one minus Amihud's illiquidity measure (2002) which is defined as follows:

$$ILLIQ_{iq} = 1/D_{iq} \sum_{t=1}^{Diq} \left|R_{iqd}\right| \; / VOLD_{ivqd} \qquad (5)$$

Here, $|R_{iqd}|$ is the absolute return of asset i on day d in quarter q, $VOLD_{ivqd}$ is the dollar volume traded of asset i on day d in quarter q, and D_{iq} is the number of days for which the data is available for stock i in quarter q. Also, *LIQUIDITY = 1-ILLIQ*.

The dividend pay-out is measured by the dividend pay-out ratio, which is the dividends declared during a period as a percent of earnings per share. Negative values (caused by negative earnings announced) are replaced by zero. The dividend pay-out ratio is expected to negatively affect beta (Logue & Merville, 1972). Operating efficiency was obtained from the ratio of recurring revenue to real estate value. To control for the effect of size, we used the natural logarithm of the market capitalization following J. C. Hartzell et al. (2014) and Gyourko and Nelling (1996). The data summary is provided in Table 1. We conducted two unit-root tests (Im-Pesaran-Shin test and Fisher-type Augmented Dickey-Fuller test using the inverse chi-squared method) for each variable.

The null hypothesis for both these tests denoted the presence of unit root. Most variables were found to be stationary. Some variables for which the null was not rejected were found to be stationary in the presence of a trend which we controlled for in our models.

The betas based on the CAPM ranged between −0.376 and 4.271 with a mean of 1.268.[6] The total number of properties located in the United States owned by the lodging REITs studied ranges between 4 and 501 across different REITs and quarters with an average of 99.13 properties owned by a given REIT during a given time period. These properties are spread out across an average of 6.55 NCREIF regions or 6.62 Economic Regions. The average allocation of a REIT's U.S. portfolio to each NCREIF region ranges between 7.96% for West North

Table 1. *Data Summary*

Variable	Obs.	Mean	Std. Dev.	Min.	Max.	IPS	Fisher
BETACAPM	677	1.27	0.86	−0.38	4.27	−3.92***	6.90***
HERF_NR	677	0.27	0.16	0.13	0.69	NA	0.78
ENTROPY2_NR	636	0.01	0.02	−0.05	0.08	NA	1.93**
ENTROPY3_NR	613	0.44	0.06	0.35	0.64	1.35	−1.56
ENTROPY4_NR	558	0.55	0.06	0.39	0.75	−0.90	-0.86
ENTROPY5_NR	494	0.64	0.05	0.53	0.77	−0.32	0.65
HERF_ER	676	0.27	0.15	0.15	0.68	NA	1.65**
ENTROPY2_ER	635	0.01	0.02	−0.03	0.08	NA	0.94
ENTROPY3_ER	599	0.46	0.05	0.35	0.62	-0.18	−0.13
ENTROPY4_ER	561	0.56	0.05	0.46	0.69	0.04	−0.40
ENTROPY5_ER	531	0.64	0.04	0.56	0.80	0.40	0.34
GROWTH	675	0.02	0.10	−0.26	1.35	−18.4***	56.4***
PROFITABILITY	675	0.00	0.07	−0.43	0.41	−17.2***	51.0***
ILLIQUIDITY	677	3.56E-06	1.57E-05	5.54E-11	1.56E-04	NA	18.51***
LN_MARKETCAP	676	20.14	1.95	15.45	23.61	0.78	−0.55
DPO_PC	668	0.72	1.11	0.00	9.00	NA	51.82***
OPEFF	670	0.09	0.13	0.01	2.23	-8.27***	17.8***

Note: The analysis is based on quarterly data on 17 lodging REITs between 1997 and 2016. GROWTH = percent change in total assets. PROFITABILITY = net income/total equity. ILLIQUIDITY = Amihud illiquidity measure. LN_MARKETCAP = natural log of market capitalization. DPO_PC = Dividend payout ratio (in percent). OPEFF = recurring revenue/real estate value. HERF = Herfindahl index (measurement of geographic concentration) of the percent share of properties held in various geographic regions. ENTROPY measures how well concentrated are the properties held in a given number (2 through 5) of top geographic regions (by property count). ER and NR suffixes denote "Economic Region" and "NCREIF" region classifications, respectively. The last two columns denote the p-value for the following unit-root (null hypothesis) tests: Im-Pesaran-Shin and Fisher-type inverse chi-squared ADF. *** and ** signify p-values at 1% and 5%, respectively.

[6] The mean market beta of the Fama French three-factor model is slightly lower at 1.126 and the mean market beta estimate of the four-factor model is even lower at 0.997.

Central to 18.82% for the Northeast. For the Economic Regions, the range is larger with an average of 24.08% allocated to the Old South and 6.16% allocated to New England. The Herfindahl indices based on the two regional classifications are very similar. The average Herfindahl index based on NCREIF regions is 27.25% while that of the Economic Regions is slightly higher at 27.32%. This indicates that on average the lodging REITs are nearly identically spread out across regions based on NCREIF and Economic Regions. The overall average of international properties in the portfolio of a given REIT in a given quarter is 2.39. However, most REITs do not own any international properties. Host Hotels & Resorts has owned up to 42 international properties within a quarter and is the only lodging REIT in our sample which owns properties outside of North America. Another four REITs have owned between one and six properties in North America but outside the United States at any given time.[7]

Methodology

We developed the time-varying market beta of the CAPM (Equation 1) through a 30-month rolling window regression. The monthly betas were averaged every quarter for further analysis. Our data represents an unbalanced panel of 17 REITs over 78 quarters with time-varying variables. All the empirical models represent a variation of the following wherein different measures of $geographic\ diversification$ are tested.

$$\beta_{it} = f(leverage_{it}, growth_{it}, size_{it}, operating\ efficiency_{it}, liquidity_{it}, profitability_{it}, dividend\ payout_{it,}\ geographic\ diversification_{it}) \quad (6)$$

To test for an appropriate estimation method, for each of the following model specifications, we ran the Breusch-Pagan Lagrange multiplier test for random effects. We rejected the null in all the cases implying that the usual OLS regression models are not suitable. Further, for each specification, we ran the Hausman test. Except for one specification,[8] the null was rejected in all cases providing support for fixed-effect (FE) models. FE models may be relatively inefficient when random effects are more suitable but provide consistent coefficient estimates. Therefore, we applied FE estimation to all the models. REIT ticker symbols served as the fixed effects. Besides, we controlled for the market trends in each model using annual dummy variables. Using the trend dummy controls for the systemic shifts over time in stock risk perception by the investors (e.g., recession).

We applied the multiple measures of geographic dispersion discussed earlier to two sets of analysis: baseline and entropy models. In the baseline models, we started with the traditional model without any geographic focus. Then, based on Gyourko and Nelling (1996) and J. C. Hartzell et al. (2014) we included the following variations of *Geographic diversification* (Equations 3 and 4) sequentially: 1) geographic footprint, i.e., the count of regions; 2) the Herfindahl index of the regional breakup; and 3) share of properties in the regions. Further, in "entropy" models, following An et al. (2011), we employed the geographic entropy measures (based on REIT-specific top-2, -3, -4, and -5 regions) as *Geographic diversification*. As a robustness test, we applied similar models to both the NCREIF and the Economic Regions classification, in separate sets of models. To test whether the findings were robust to other measures of systematic risk, we analyzed these models for equity beta developed from Fama French three-factor and Carhart's four-factor models as well,[9] but did not report them for brevity.

Results and Discussion

Tables 2 and 3 present the results of the baseline models using the NCREIF and Economic Region classifications, respectively. The results are broadly consistent across the two classifications.

The first (Baseline) model, which is based on earlier findings (i.e., control variables), has the explanatory power of 71%. Several REIT fixed effects and annual trend dummies were statistically significant

[7] The four REITs are AHT, DRH, FCH, and HPT, and for the purpose of this study "North America outside the United States" includes Canada, Puerto Rico and the U.S. Virgin Islands.

[8] When the CAPM beta was regressed with the top-2 NCREIF regions based entropy.

[9] The results are consistent and available upon request.

Table 2. *Fixed Effects Models for CAPM Beta with NCREIF Geographic Classification*

	Baseline	Regional Footprint	Regional Herfindahl	Regional Breakup
LEVERAGE_DA	0.0433	−0.0155	0.0479	0.0858
	(0.205)	(0.207)	(0.205)	(0.275)
GROWTH	−0.265	−0.247	−0.260	−0.102
	(0.168)	(0.168)	(0.168)	(0.163)
PROFITABILITY	−0.379	−0.371	−0.379	−0.458*
	(0.278)	(0.278)	(0.278)	(0.266)
LIQUIDITY	8,140***	8,186***	8,105***	7,944***
	(1,817)	(1,815)	(1,817)	(1,738)
LN_MARKETCAP	−0.134***	−0.139***	−0.139***	−0.230***
	(0.0293)	(0.0294)	(0.0298)	(0.0361)
DPO_PC	−0.0306*	−0.0301*	−0.0300*	−0.0191
	(0.0161)	(0.0161)	(0.0161)	(0.0158)
OPEFF	0.366*	0.354*	0.365*	0.343*
	(0.191)	(0.191)	(0.191)	(0.183)
INT_VS_US				0.0927
				(0.537)
NCREIF_EN				−3.032***
				(1.061)
NCREIF_ME				0.275
				(0.669)
NCREIF_MT				−5.169***
				(1.543)
NCREIF_NE				−3.064***
				(0.744)
NCREIF_PC				1.263*
				(0.679)
NCREIF_SE				−3.764***
				(0.680)
NCREIF_SW				−0.795
				(0.795)
NCREIF_REG_COUNT		0.0594*		
		(0.0351)		
HERF_NR			0.526	
			(0.518)	
Constant	−8,137***	−8,183***	−8,102***	−7,937***
	(1,817)	(1,815)	(1,817)	(1,738)
Annual Trend Dummies	Included	Included	Included	Included
REIT Fixed Effects	Included	Included	Included	Included
Observations	659	659	659	659
R-squared	0.712	0.714	0.713	0.744

Note: Dependent variable = CAPM beta. Standard errors in parentheses. Unit of analysis = REIT-Quarter. ***p < 0.01, **p < 0.05, *p < 0.1. The analysis is based on quarterly data on 17 lodging REITs between 1997 and 2016. LEVERAGE_DA = total debt/total assets. GROWTH = percent change in total assets. PROFITABILITY = net income/total equity. LIQUIDITY = 1-Amihud illiquidity measure. LN_MARKETCAP = natural log of market capitalization. DPO_PC = Dividend payout ratio (in percent). OPEFF = recurring revenue/real estate value. INT_VS_US = international properties/US-based properties. Suffixes to NCREIF denote proportion of properties held by a REIT in the NCREIF region (ME = Mideast, MT = Mountain, NE = Northeast, PC = Pacific, SE=Southeast, SW = Southwest, omitted group = West North Central). NCREIF_REG_COUNT = number of NCREIF regions in which the REIT holds properties. HERF_NR = Herfindahl index (measurement of geographic concentration) of the percent share of properties held in various NCREIF regions. The smaller the Herfindahl index, the higher the geographic diversification.

in each of the models. Afterward, we introduced geographic variables sequentially. In both the geographic classifications (Tables 2 and 3), control variables such as leverage and growth were insignificant, although with expected signs. The insignificant leverage variables support the Modigliani and Miller proposition that in absences of taxes (which is a prominent characteristic of REITs), capital struc-

Table 3. *Fixed Effects Models for CAPM Beta with Economic Region Classification*

	Baseline	Regional Footprint	Regional Herfindahl	Economic Regions
LEVERAGE_DA	0.0433	−0.0789	−0.00970	0.284
	(0.205)	(0.211)	(0.204)	(0.254)
GROWTH	−0.265	−0.238	−0.275	−0.184
	(0.168)	(0.168)	(0.167)	(0.162)
PROFITABILITY	−0.379	−0.382	−0.359	−0.471*
	(0.278)	(0.277)	(0.277)	(0.265)
LIQUIDITY	8,140***	8,142***	8,550***	8,730***
	(1,817)	(1,811)	(1,813)	(1,732)
LN_MARKETCAP	−0.134***	−0.161***	−0.148***	−0.194***
	(0.0293)	(0.0314)	(0.0296)	(0.0382)
DPO_PC	−0.0306*	−0.0280*	−0.0249	−0.0177
	(0.0161)	(0.0161)	(0.0161)	(0.0157)
OPEFF	0.366*	0.358*	0.337*	0.362**
	(0.191)	(0.191)	(0.191)	(0.182)
INT_VS_US				−0.651
				(0.539)
ER_FARM				−5.834***
				(0.981)
ER_MIDWEST				−5.571***
				(0.952)
ER_MIDATL				−2.514**
				(1.149)
ER_MINERAL				−6.578***
				(0.966)
ER_NEWENG				−5.659***
				(1.055)
ER_NORTHCALIF				−6.296***
				(1.474)
ER_OLDSOUTH				−7.383***
				(0.925)
ER_COUNT		0.0762**		
		(0.0327)		
HERF_ER			−1.520***	
			(0.535)	
Constant	−8,137***	−8,139***	−8,546***	−8,720***
	(1,817)	(1,811)	(1,812)	(1,732)
Annual Trend Dummies	Included	Included	Included	Included
REIT Fixed Effects	Included	Included	Included	Included
Observations	659	659	659	659
R-squared	0.712	0.715	0.716	0.748

Note: Dependent variable = CAPM Beta. Standard errors in parentheses. Unit of analysis = REIT-Quarter. ***p < 0.01, **p < 0.05, *p < 0.1. The analysis is based on quarterly data on 17 lodging REITs between 1997 and 2016. LEVERAGE_DA = total debt/total assets. GROWTH = percent change in total assets. PROFITABILITY = net income /total equity. LIQUIDITY = 1-Amihud illiquidity measure. LN_MARKETCAP = natural log of market capitalization. DPO_PC = Dividend payout ratio (in percent). OPEFF = recurring revenue/real estate value. INT_VS_US = international properties/US-based properties. Suffixes to ER denote proportion of properties held by a REIT in the Economic Region (FARM = Farmbelt, MIDWEST = Industrial Midwest, MIDATL = Mid-Atlantic Corridor, MINERAL = Mineral Extraction Area, NEWENG = New England, NORTHCALIF = Northern California, OLDSOUTH = Old South, Omitted Group = Southern California). ER_COUNT = number of economic regions in which the REIT holds properties. HERF_ER = Herfindahl index (measurement of geographic concentration) of the percent share of properties held in various economic regions. The smaller the Herfindahl index, the higher the geographic diversification.

ture has no impact on the cost of capital. GROWTH may still have a significant effect in the cross-section of firms. However, the cross-sectional variations are already captured in the REIT fixed effects (of which several are highly significant, but not reported for brevity). In the Regional Breakup models, PROFITABILITY was significantly negative as expected implying that increased profitability reduces the

systematic risk. The models suggested that LIQUIDITY has a significantly positive association with beta, which is in line with Jensen and Meckling's (1976) theory of agency costs. We also found that firm size has a significantly negative association with the beta. In particular, each percent increase in the firm's MARKETCAP reduces the beta by 0.13 to 0.23, controlling for other factors. Larger firms may be able to diversify their portfolios efficiently, which may lead to reduced systematic risk perception (H. Kim, Gu, & Mattila, 2002). REIT investors' preference for high dividend pay-out (DPO_PC) is well-known. A REIT meeting this expectation signals stability, which reduces the risk. These two tables (2 and 3) show a positive association of operating efficiency with the beta, which is somewhat puzzling. However, latter models (Tables 4 and 5) suggest negative coefficients. The inconsistent coefficient sign may be due to this variable's multicollinearity with the geographic variables as reflected in high Pearson correlation coefficients (see Appendix Table 5).

The second model (in Tables 2 and 3) describes the effect of regional footprint. With each additional NCREIF (Economic) region in the portfolio, the beta increases by 0.06 (0.08). The coefficients are statistically significant implying that a REIT with wider geographic exposure compared to other REITs of similar characteristics may be perceived to be lacking focus, irrespective of how the regional classification is visualized. Compared to the baseline model, this model shows marginal improvement in the R-squared in both the geographic classifications.

Table 4. *Fixed Effects Models for CAPM Beta with NCREIF Geographic Entropy*

	Entropy-Top 2 Regions	Entropy-Top 3 Regions	Entropy-Top 4 Regions	Entropy-Top 5 Regions
LEVERAGE_DA	0.208	−0.0728	0.135	0.104
	(0.202)	(0.209)	(0.222)	(0.238)
GROWTH	−0.198	−0.184	−0.166	−0.165
	(0.165)	(0.177)	(0.182)	(0.195)
PROFITABILITY	−0.172	−0.0541	−0.0217	0.127
	(0.336)	(0.342)	(0.355)	(0.381)
LIQUIDITY	7,000	9,029*	9,202*	10,984*
	(4,990)	(5,012)	(5,438)	(5,747)
LN_MARKETCAP	−0.171***	−0.220***	−0.276***	−0.314***
	(0.0362)	(0.0410)	(0.0440)	(0.0494)
DPO_PC	−0.0250	−0.0204	−0.0179	−0.0105
	(0.0155)	(0.0160)	(0.0167)	(0.0204)
OPEFF	−0.492	−1.614	−2.392**	−2.512**
	(0.923)	(0.986)	(1.036)	(1.121)
ENTROPY2_NR	−4.706***			
	(1.364)			
ENTROPY3_NR		−2.322***		
		(0.593)		
ENTROPY4_ NR			−1.911***	
			(0.522)	
ENTROPY5_ NR				−0.942
				(0.817)
Constant	−6,996	−9,023*	−9,195*	−10,976*
	(4,990)	(5,012)	(5,438)	(5,746)
Annual Trend Dummies	Included	Included	Included	Included
REIT Fixed Effects	Included	Included	Included	Included
Observations	624	602	549	485
R-squared	0.746	0.746	0.734	0.733

Note: Dependent variable = CAPM beta. Standard errors in parentheses. Unit of analysis = REIT-Quarter. ***p < 0.01, **p < 0.05, *p < 0.1. The analysis is based on quarterly data on 17 lodging REITs between 1997 and 2016. LEVERAGE_DA = total debt/total assets. GROWTH = percent change in total assets. PROFITABILITY = net income /total equity. LIQUIDITY = 1-Amihud illiquidity measure. LN_MARKETCAP = natural log of market capitalization. DPO_PC = Dividend payout ratio (in percent). OPEFF = recurring revenue/real estate value. INT_VS_US = international properties/US-based properties. ENTROPY measures how well concentrated are the properties held in a given number (2 through 5) of top NCREIF regions (by property count) denoted by NR suffix. The maller the ENTROPY, the larger the geographic diversification in the top regions.

Table 5. *Fixed Effects Models for CAPM Beta with Economic Regions Geographic Entropy*

VARIABLES	Entropy-Top 2 Regions	Entropy-Top 3 Regions	Entropy-Top 4 Regions	Entropy-Top 5 Regions
LEVERAGE_DA	0.231	−0.226	0.0202	0.368*
	(0.195)	(0.208)	(0.222)	(0.221)
GROWTH	−0.252	−0.109	−0.188	−0.0411
	(0.159)	(0.161)	(0.186)	(0.165)
PROFITABILITY	−0.299	−0.349	−0.0179	−1.388***
	(0.324)	(0.337)	(0.361)	(0.442)
LIQUIDITY	11,614**	3,932	7,012	−101,827**
	(4,870)	(5,145)	(5,564)	(48,264)
LN_MARKETCAP	−0.199***	−0.173***	−0.265***	−0.194***
	(0.0334)	(0.0381)	(0.0447)	(0.0547)
DPO_PC	−0.0251*	−0.0139	−0.0154	−0.0150
	(0.0150)	(0.0155)	(0.0167)	(0.0144)
OPEFF	−0.637	−0.140	−2.326**	−1.107
	(0.878)	(0.964)	(1.057)	(1.045)
ENTROPY2_ER	−8.225***			
	(1.114)			
ENTROPY3_ER		−5.301***		
		(0.634)		
ENTROPY4_ER			−0.293	
			(0.653)	
ENTROPY5_ER				−0.130
				(0.561)
Constant	−11,610**	−3,926	−7,006	101,831**
	(4,870)	(5,145)	(5,563)	(48,264)
Annual Trend Dummies	Included	Included	Included	Included
REIT Fixed Effects	Included	Included	Included	Included
Observations	624	589	552	522
R-squared	0.763	0.767	0.746	0.795

Note: Dependent variable = CAPM Beta. Standard errors in parentheses. Unit of analysis = REIT-Quarter. ***p < 0.01, **p < 0.05, *p < 0.1. The analysis is based on quarterly data on 17 lodging REITs between 1997 and 2016. LEVERAGE_DA = total debt/total assets. GROWTH = percent change in total assets. PROFITABILITY = net income/total equity. LIQUIDITY = 1-Amihud illiquidity measure. LN_MARKETCAP = natural log of market capitalization. DPO_PC = Dividend payout ratio (in percent). OPEFF = recurring revenue/real estate value. INT_VS_US = international properties/US-based properties. ENTROPY measures how well concentrated are the properties held in a given number (2 through 5) of top economic regions (by property count) denoted by ER suffix. The smaller the ENTROPY, the larger the geographic diversification in the top regions.

In the following specification, we replaced the geographic footprint by regional Herfindahl indices. The NCREIF Herfindahl index is insignificant; however, the Economic Region Herfindahl index has a significantly negative coefficient, which is consistent with Gyourko and Nelling (1996). The R-squared in the NCREIF-based model marginally reduces, but slightly improves in the Economic-Region based model. The finding implies that investors are sensitive to the geographic focus of REITs particularly when the regional classification is economically based. The higher the geographic focus, the lower the systematic risk.

Finally, similar to Gyourko and Nelling (1996), we introduced the allocation of a REIT portfolio to various regions. This improves the R-squared (74% in NCREIF and 75% in Economic Region classification). We found that international diversification has an insignificant association with the beta, which is in line with studies such as Ziobrowski and Ziobrowski (1995) and Stevenson (1999). From Table 2, allocation to the NCREIF_PC (Pacific) region significantly increases the beta (w.r.t. West North Central). However, some other regions are associated with significantly lower beta (sequentially, from high to low: East North Central, Northeast, Southeast, and Mountain). From Table 3, Southern California is associated with the highest beta. All other regions are associated with significantly lower beta (sequentially, from high to low:

Mid-Atlantic Corridor, Industrial Midwest, New England, Northern California, Mineral Extraction Area, and Old South).

In the following step, we posited geographic entropy as the measure of geographic focus. Tables 4 and 5 present the results. Similar to earlier analyses, the first table (4) applies the NCREIF regional classification and the second (5) applies the Economic Region classification. The estimated models in the two tables, otherwise, are the same. As discussed earlier, entropy measures consider a REIT's concentration of assets within its own top *N* regions. If a REIT's portfolio is scattered in *K* regions such that *K>N,* then the entropy measure ignores the assets in the (*K–N*) regions. Therefore, a high entropy measure could be interpreted as how geographically focused a REIT is even within its selected top-preferred locations.

Inclusion of entropy measures (based on $N = 2$, 3, 4, and 5) substantially improved the explanatory power of the models, which went up to 73–75% in NCREIF-based regional classification (Table 4) and 75–80% in Economic-Region based geographic classification (Table 5). Despite their higher R-squared, several control variables in the entropy models are rendered insignificant. This further lends support to the entropy measure as a more effective measurement of geographic focus in REITs as determinants of systematic risk. A more remarkable feature of the entropy measures is that with an increase in *N,* the entropy measure's potential to reduce the systematic risk gradually falls. For example, in Table 4 (based on NCREIF regional classification) the coefficient of ENTROPY2 is −4.7 implying that each 0.1 increase in entropy is associated with 0.47 decrease in beta. However, beta's sensitivity to the entropy reduces to −2.3 if the entropy is based on top-3 regions rather than top-2 regions as in the earlier model. For ENTROPY4, the coefficient shrinks to −1.9 and for ENTROPY5 it further shrinks to −0.9 and even becomes insignificant. Similarly, in Table 5 (based on economic regional classification) the coefficient of ENTROPY2 is −8.2 implying that each 0.1 increase in entropy is associated with 0.82 decrease in beta. However, beta's sensitivity to the entropy decreases to −5.3 if the entropy is based on top-3 regions rather than 2. For ENTROPY4 and ENTROPY5 the coefficients further shrink to −0.29 and −0.13, respectively, and become insignificant. The results affirmed the earlier finding in this study that geographic focus reduces the systematic risk. Besides, staying more focused on a limited number of regions has significantly stronger potential in reducing the systematic risk. If the focus is diluted beyond two or three regions, the negative association between geographic focus and beta ceases to exist.

Conclusion and Implications

As geographic diversification is the most commonly adopted diversification strategy by real estate investors in general (Cheng & Roulac, 2007; Cotter et al., 2015; Eichholtz et al., 1995; Nelson & Nelson, 2003; S. Lee & Byrne, 1998) and tourism/hospitality investors in particular (Sharpley & Vass, 2006; S. Lee, 2008), it is important to investigate the effectiveness of this strategy in reducing the risk. A number of studies have focused on identifying the best way to diversify geographically in the context of real estate investment. However, a contrasting strand of studies cautions against the increased risk arising from geographic diversification (Landier et al., 2009; John et al., 2011; Cashman et al., 2014; Das & Thomas, 2016). We reconciled the earlier findings and applied our analysis to a sample of lodging REITs.

We examined the association between geographic focus and systematic risk for real estate owners. In particular, we applied firm-fixed effect models to a panel of 17 lodging focused REITs through 20 years of quarterly data. Using rolling regression in CAPM models, we first developed the time-varying systematic risk measure (i.e., beta) for REIT stocks. Further, using the asset holding, acquisition and disposition history of REITs, we developed a time-varying geographic composition of each REIT each quarter. For robustness, we used two different regional classifications: 1) NCREIF regions and 2) Salomon Brothers' Economic Regions.[10] We developed the following time-varying measures of geographic focus: 1) number of regions in which a REIT holds assets; 2) percent allocation of assets to individual regions;

[10] For further robustness, we also developed beta measures based on Fama French three-factor and Carhart's four-factor stock pricing models. The results were broadly consistent but not reported for brevity.

3) Herfindahl index of the regional allocation; and 4) different entropy indices of geographic focus in two, three, four and five top regions for each REIT. We showed that regional allocation has significant association with the systematic risk. Increased geographic footprint (i.e., number of regions) is associated with significantly higher beta. The Economic Region Herfindahl index had a significantly negative association with beta suggesting that regional focus reduces the systematic risk. From the analysis of entropy indices, we inferred that staying focused on one or two regions has the strongest association with reduced systematic risk. However, when this focus was expanded based on a larger number of preferred regions, the association became statistically insignificant.

Our study has business implications. Local soft information is a critical determinant for the success of location-specific businesses such as real estate or hospitality, the lack of which may lead to uncertainties for both managers and investors. As a result, the systematic risk may increase, giving rise to higher required premium on the cost of equity and, by inference, to the cost of capital. Higher cost of capital may adversely impact the asset valuation for a firm. Therefore, firms such as hotels must develop their geographic strategies carefully.

Our study has a few limitations. First, the count of assets per region may not be the most efficient method of measuring the capital allocation to various regions and is a result of data availability. Instead of the asset count, asset values or cash flows from assets may provide superior measures. Second, portfolio managers may consider allocating "risk" to regions in addition to the capital allocation. Further studies are warranted to expand the scope to other property types such as offices and apartments.

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Appendix Table 1. *Comparing Measures of Diversification Using Simulated Data*

Imaginary Geographic Allocation of Assets									Corresponding Measures of Geographic Concentration					
	Geo1	Geo2	Geo3	Geo4	Geo5	Geo6	Geo7	Geo8	#Locations	Herfindahl	Entropy2	Entropy3	Entropy4	Entropy5
REIT-1	13%	13%	13%	13%	13%	13%	13%	13%	8	0.125	0.277	0.351	0.431	0.520
REIT-2	14%	14%	14%	14%	13%	13%	13%	5%	8	0.131	0.287	0.371	0.465	0.564
REIT-3	14%	14%	14%	14%	14%	14%	14%	0%	8	0.143	0.287	0.371	0.465	0.576
REIT-4	17%	17%	17%	17%	17%	17%	0%	0%	6	0.167	0.298	0.396	0.515	0.667
REIT-5	30%	20%	17%	17%	17%	0%	0%	0%	6	0.213	0.306	0.444	0.610	0.878
REIT-6	20%	20%	20%	20%	20%	0%	0%	0%	5	0.200	0.307	0.432	0.600	NA
REIT-7	25%	25%	25%	25%	0%	0%	0%	0%	4	0.250	0.315	0.500	NA	NA
REIT-8	50%	40%	10%	0%	0%	0%	0%	0%	3	0.420	0.439	NA	NA	NA
REIT-9	50%	50%	0%	0%	0%	0%	0%	0%	2	0.500	NA	NA	NA	NA
REIT-10	100%	0%	0%	0%	0%	0%	0%	0%	1	1.000	NA	NA	NA	NA

Note: The table lays out how various geographic concentration measures could vary across calculation methods for a given REIT. Ten imaginary REITs are shown to have different shares of properties within their portfolio across eight imaginary regions.

Appendix Table 2. *Correlation Matrix of Various Geographic Concentration Measures Applied to the Quarterly Panel Data of REITs*

	HERF_NR	ENT2_NR	ENT3_NR	ENT4_NR	ENT5_NR	HERF_ER	ENT2_ER	ENT3_ER	ENT4_ER
HERF_NR	1								
ENT2_NR	−0.8591	1							
ENT3_NR	0.5054	−0.4984	1						
ENT4_NR	0.5679	−0.5183	0.9504	1					
ENT5_NR	0.3571	−0.3286	0.8	0.8616	1				
HERF_ER	0.4863	−0.4617	0.2181	0.2331	0.127	1			
ENT2_ER	−0.0522	0.072	0.1179	0.1486	0.1692	−0.0331	1		
ENT3_ER	0.2089	−0.0921	0.1101	0.1104	−0.0294	0.5258	−0.0896	1	
ENT4_ER	0.3567	−0.2298	0.1171	0.1099	−0.0679	0.5353	−0.3195	0.7923	1
ENT5_ER	0.383	−0.3366	0.2686	0.2767	0.1171	0.0801	−0.4125	0.3728	0.6595

Note: HERF = Herfindahl index (measurement of geographic concentration) of the percent share of properties held in various geographic regions. ENT measures the geographic entropy, i.e., how well concentrated are the properties held in a given number (2 through 5) of top geographic regions (by property count). NR and ER suffixes denote NCREIF region and Economic Region classifications, respectively.

Appendix Table 3. *Additional Descriptive Statistics*

Variable	N	Min.	Max.	Mean	Std. Dev.
Fama French Three-Factor Model Beta	677	−1.54	4.82	1.13	0.74
Four-Factor Model Beta	677	−1.60	4.29	1.00	0.66
Total Properties in the US	677	4.00	501.00	99.13	111.21
% EN NR	677	0.00	0.28	0.08	0.05
% ME NR	677	0.00	0.47	0.16	0.10
% MT NR	677	0.00	0.80	0.10	0.18
% NE NR	677	0.00	0.82	0.19	0.19
% PC NR	677	0.00	0.56	0.17	0.14
% SE NR	677	0.00	0.64	0.15	0.11
% SW NR	677	0.00	0.27	0.08	0.07
% WN NR	677	0.00	0.57	0.08	0.13
% Farmbelt	677	0.00	0.66	0.09	0.15
% Industrial Midwest	677	0.00	0.75	0.18	0.12
% Mid-Atlantic Corridor	677	0.00	0.39	0.08	0.07
% Mineral Extraction Area	677	0.00	0.38	0.12	0.09
% New England	677	0.00	0.34	0.06	0.07
% Northern California	677	0.00	0.38	0.06	0.07
% Old South	677	0.00	0.73	0.24	0.17
% Southern California	677	0.00	0.80	0.15	0.18
Number of Economic Regions	677	2.00	8.00	6.62	1.89

Appendix Table 4. *Panel Data Summary of REITs Included in the Study*

TICKER	Freq.	Percent	Cum.
AHT	42	6.2	6.35
CDOR	77	11.37	17.73
CHSP	16	2.36	20.09
CLDT	13	1.92	22.01
DRH	35	5.17	27.18
FCH	78	11.52	38.7
HPT	74	10.93	49.63
HST	60	8.86	58.49
HT	60	8.86	67.36
IHT	40	5.91	73.26
INN	12	1.77	75.04
LHO	63	9.31	84.34
PEB	17	2.51	86.85
RHP	4	0.59	87.44
RLJ	11	1.62	89.07
SHO	37	5.47	94.53
SOHO	37	5.47	100
Total	677	100	

Appendix Table 5. *Break Up of Panel Data across Years*

Year	Freq.	Percent	Cum.
1997	5	0.74	0.74
1998	11	1.62	2.36
1999	12	1.77	4.14
2000	12	1.77	5.91
2001	18	2.66	8.57
2002	24	3.55	12.11
2003	24	3.55	15.66
2004	24	3.55	19.2
2005	24	3.55	22.75
2006	28	4.14	26.88
2007	36	5.32	32.2
2008	44	6.5	38.7
2009	44	6.5	45.2
2010	44	6.5	51.7
2011	44	6.5	58.2
2012	47	6.94	65.14
2013	55	8.12	73.26
2014	64	9.45	82.72
2015	65	9.6	92.32
2016	52	7.68	100
Total	677	100	

Appendix Table 6. *Correlation of OPEFF with Selected Geographic Variables*

Geographic Variable	Correlation with OPEFF
NCREIF_ME	0.1186
NCREIF_MT	−0.2478
NCREIF_NE	−0.2149
NCREIF_PC	−0.0959
NCREIF_SE	0.0972
NCREIF_SW	−0.2088
NCREIF_WN	0.2345
NCREIF_REG_COUNT	−0.1398
HERF_NCREIF	0.2089
ENTROPY2_NR	−0.1814
ENTROPY3_NR	0.2107
ENTROPY4_NR	0.2696
ENTROPY5_NR	0.2496

Note: The analysis is based on quarterly data on 17 lodging REITs between 1997 and 2016. OPEFF = recurring revenue/real estate value. NCREIF suffixes denote the regional classifications defined by the National Council of Real Estate Investment Fiduciaries. The variable measures the percentage of properties a REIT has that are located in the specified region. NCREIF_REG_COUNT = the number of NCREIF regions in which a REIT holds properties. HERF = Herfindahl index (measurement of geographic concentration) of the percent share of properties held in various geographic regions. ENTROPY measures how well concentrated are the properties held in a given number (2 through 5) of top geographic regions (by property count). ER and NR suffixes denote "Economic Region" and "NCREIF" region classifications, respectively.